

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Appln. Of: Hiroaki YOKOYAMA

Serial No.: 08/992,767

Filed: December 17, 1997

For: CONTACT STRUCTURE IN SEMICONDUCTOR INTEGRATED ...

Group: 2814

Examiner: D. Wille

DOCKET:
NEC 19654

The Assistant Commissioner of Patents & Trademarks
Washington, D.C. 20231

APPELLANT'S BRIEF ON APPEAL

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603-668-1400

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Dear Sir:

This Brief is being filed in support of Appellant's Appeal from the Final Rejection by the Examiner, the Notice of which was timely filed on October 25, 1999

The Real Party in Interest in this application is NEC Corporation, which has a place of business at 7-1, Shiba 5-chome, Minato-ku, Tokyo 108-01, JAPAN. NEC Corporation received an assignment of all right, title and interest in the application through an assignment executed by the inventor, Hiroaki Yokayama, on December 17, 1997 and by virtue of his employment by NEC Corporation. The assignment is recorded in the U.S. Patent and Trademark Office at Reel 8930, Frame 0303.

Related Appeals and Interferences

There are no appeals or interferences that would directly affect, or be directly affected by, or have a bearing on the Board's decision in the present appeal.

Status of the Claims

Claims 1 - 4, 7 and 8 stand rejected under 35 USC § 103(a) as being unpatentable over Roberts et al (US Patent No. 5,730,835) in view of Miller et al (US Patent No. 5,714,804).

Claims 1-4, 7 and 8 stand rejected under 35 USC § 103(a) as being unpatentable over McDavid (US Patent No. 4,507,853) in view of Miller et al.

Claims 5, 6, 9 and 10 stand rejected under 35 USC § 103(a) as being unpatentable over McDavid and Roberts et al in view of Miller et al.

Status of the Amendments

In the Advisory Action dated September 27, 1999, the Examiner indicated that Appellant's "Amendment B Under Rule 116" filed on August 25, 1999 will be entered upon filing of a Notice of Appeal and an Appeal Brief.

Summary of the Invention

A major focus of the claimed invention is to overcome the deficiencies of prior art methods for creating contact structures in semiconductor integrated circuits. Page 5,

lines 8-11.¹ In the manufacture of semiconductor integrated circuits, contact electrodes are formed in the circuit to provide electrical connection to both internal and external components. In the prior art, as shown for example in Figures 1A and 1B, a contact hole 9 has been formed in a silicon oxide 2 to expose a semiconductor substrate 1 in the area of a desired contact point. Page 1, lines 19-22. Thereafter a wire conducting layer is formed over the entire surface of the substrate and film 2. Page 1, line 23 to Page 2, line 1. Alternatively, as shown in Figures 2A through 2C, a layer of refractory material may be deposited on the silicon oxide 2 and then etched to leave only refractory sidewall 6 in the contact hole 9. Page 2, line 26 to Page 3, line 2. The wire conducting layer 8 is then deposited over the structure to extend down into the contact hole and in contact with the semiconductor substrate 1. Page 3, lines 16-19.

As the density of semiconductor integrated circuits has increased, it has become difficult to form contacts with sufficient contact resistance in relatively small contact holes. Page 2, lines 3-8 and Page 4, lines 14-19. In addition, in semiconductor integrated circuits having relatively large-diameter contact holes and also relatively small-diameter contact holes, the prior art has failed to provide a method which allows for stable contact resistance in both the large-diameter and small-diameter holes. Page 4, lines 20-24. One reason for this is discussed at page 4, line 25 to page 5, line 6, wherein it is stated:

For example, when the sidewall of the refractory metal is formed to fit with small-diameter contact holes, it is necessary to form the refractory

¹ References herein to "Page X, lines x-x" refer to page and line numbers of the Specification in the present application.

metal layer having a thin film thickness to ensure that the small-diameter holes are never completely filled by the refractory metal. However, if the refractory metal layer having the thin film thickness is formed, the film thickness of the sidewall of the refractory metal in the large-diameter contact holes becomes too thin, so that the aluminum wiring conductor layer will disconnect at the bottom of the contact hole, with the result that the contact resistance becomes high.

To overcome the deficiencies of the prior art, the Appellant provides a semiconductor device that includes both large-diameter contact holes 3 and small-diameter contact holes 4 formed to penetrate an insulator film 2 to reach to a semiconductor substrate 1, as shown for example in FIG. 3. Page 10, lines 17-21. The small-diameter contact hole 4 is completely filled with a refractory conductive metal 5, as shown for example in FIG. 4C. Page 10, lines 21-22. Simultaneously, the large-diameter contact hole 3 is partially filled by the refractory metal. Page 10, lines 22-26; Page 11, lines 18-24.

Thereafter the refractory metal 5 is etched. Page 11, line 25 to Page 12, line 2. As a result the small-diameter hole 4 is filled with a plug 7 of the refractory metal, and the large-diameter hole is filled to cover a sidewall surface of the large-diameter contact hole to below the upper end of the large-diameter contact hole by a predetermined distance, as shown for example in FIG. 4D. Page 12, lines 2-8. A wiring conductor is deposited on the insulator film to cover the top surface of the plug filling the small-diameter contact hole. Page 12, lines 9-12. The wiring conductor also fills, at least in part, the space remaining in the large-diameter contact hole, as shown for example in FIG. 3.

In a second exemplary embodiment of the invention, the large-diameter hole 3 and the small-diameter hole 4 have a funnel-shaped portion 3A or 4A form on an upper portion thereof to open or spread upward, as shown for example in FIG. 6A. Page 13, lines 12-14. Then, "excluding the funnel-shaped portion 3A, the small-diameter contact hole 4 is completely filled with a plug 7 of refractory conductive material." Page 13, lines 15-16. The large-diameter contact hole 3 is filled with a sidewall 6 formed of the refractory material covering a side surface of the hole 3 lower "lower than a position which is lower than, by a predetermined distance, a boundary 3D between a vertical side surface of the large-diameter contact hole 3 and the funnel shaped portion 4A." Page 13, lines 19-22. A wiring conductor layer 8 is then deposited to cover the upper surface of the device, as shown for example in FIG. 5. Advantages of the second embodiment are discussed in the specification at page 15, line 21 to page 16, line 6, wherein it is stated:

In this second embodiment, since the funnel-shaped portion 3A is formed to extend from the upper end of the large-diameter contact hole 3B and since the sidewall 6 of the refractory conductive material is formed to cover the side surface of the large-diameter contact hole 3B lower than the upper end 3D of the large-diameter contact hole 3B by the predetermined distance, the hole defined by the funnel-shaped portion 3A, the large-diameter contact hole 3B and the sidewall 6 has an upper end diameter larger than a bottom diameter, in other words, has a general shape which may be called a reverse-truncated cone. In addition, this reverse truncated cone has an inclination angle gentler than that of the reverse-truncated cone in first embodiment. Namely, the contact hole has the apparent aspect ratio further improved or reduced in comparison with the first embodiment.

Thus the invention described in the claims on Appeal provides significant advantages over prior art structures, as stated for example at page 16, lines 19-27, wherein it is said:

With this feature, even if the interlayer insulator film becomes thick or even if the contact hole becomes fine because of the advanced high integrated density and highly fine patterning of the semiconductor integrated circuit, the wiring conductor layer never disconnect at the bottom of the contact hole, with the result that the contact resistance is stable and low.

Issues Presented on Appeal

1. Whether claims 1-4, 7 and 8 are unpatentable under 35 USC § 103(a) as being obvious in view of Roberts et al combined with Miller et al.
2. Whether claims 1-4, 7 and 8 are unpatentable under 35 USC § 103(a) as being obvious in view of McDavid combined with Miller et al.
3. Whether claims 5, 6, 9 and 10 are unpatentable under 35 USC § 103(a) as being obvious in view of McDavid and Roberts et al combined with Miller et al.

Grouping of Claims

Claim 1 is an independent claim, and claims 2-10 depend either directly or ultimately therefrom. There are two groups of claims on appeal; the group of claims 1-4, 7 and 8, and the group of claims 5, 6, 9, and 10. The claims do not stand or fall together, as is shown herein.

Argument

- (1). Rejection of claims 1-4, 7 and 8 under 35 U.S.C. §103(a) as being unpatentable over Roberts et al. in view of Miller et al.

The Examiner has combined the teachings of Roberts and Miller to reject claims 1-4, 7 and 8 under 35 U.S.C. §103(a). In making this rejection, the Examiner states:

With respect to claims 1-4, 7 and 8, Roberts et al. show (see cover Figure and column 2, line 37-column 7, line 12) a structure with a wide via (low aspect ratio) in an insulating layer 12 where a tapered refractory metal layer 30 is formed in the corners of the hole to improve step coverage of the metal film 40 and the upper end of the hole is funnel shaped. Miller et al. show (see cover Figure and column 5, line 22-column 6, line 30) the filling of a high aspect ratio hole (column 2, line 43) with a refractory metal plug. It would have been obvious to include a technique for filling a high aspect ratio hole along with an approach for filing a low aspect ratio hole to provide a broader applicability to the electroding technique. Paragraph 5 of the Official Action mailed May 25, 1999.

The primary reference to Roberts et al. ("Roberts") teaches a method for providing improved step coverage of contacts with conductive materials. As shown in FIGS. 2-4 of Roberts, a first conductive layer 14 is deposited over an insulating layer 12. Col. 5, lines 19-20. A contact opening or contact 20 may be formed, either before or after depositing of the layer 14, through the insulating layer 12 to the circuit element 10. Col. 5, lines 20-24. A facet etch is performed to slope the conductive layer overlying the contact opening lip 27. Col. 6, lines 6-8. The etched material is deposited into the lower corner of the contact. Col. 6, lines 35-40. A second conductive layer 40 may then be deposited into the contact to supplement coverage provided by the first conductive layer and the facet etch. Col. 6, lines 63-64.

Roberts is, however, completely devoid of any teaching or suggestion of a semiconductor device, as required by independent claim 1 and the claims which depend therefrom. In particular, all of the claims on appeal require "device including both a large-diameter contact hole and a small-diameter contact hole" wherein a "refractory conductive material is simultaneously deposited in said small-diameter hole and said large-diameter hole." (emphasis added). Also, according to all of the claims on appeal, small-diameter hole is "completely filled" with the refractory material and the large-diameter hole is partly filled with the refractory material "covering a sidewall surface to below the upper end of said large-diameter contact hole by a predetermined distance."

On the contrary, Roberts teaches only a process wherein a hole is partly filled with a conductive material which is sputtered into the corners of the hole during the process of creating a facet etch. This is confirmed at col. 6, lines 35-52, wherein it is stated:

As illustrated in FIG. 3, the material removed from the upper corner 26 (FIG. 2) of the first conductive layer 14 also acts as a sputter deposition target, so that at least some of the conductive material of the upper corner 26 (FIG. 2) is deposited into a lower corner 30 of the contact 20 to form a conductive corner fill 32 (FIG. 3). FIGS. 2 and 3 show a cross-sectional view of the contact 20, wherein the backwall is omitted from the views for simplicity. Material sputtered from the upper corner 26 on a right side 36 of the contact 20 is deposited in the lower corner 30 on a left side 37. Conversely, material sputtered from the upper corner 26 on the left side 37 is deposited in the lower corner on the right side 36. Similarly, material from every point of the upper corner 26 all around the mouth of the contact 20 are sputtered to a point diagonally opposite in the lower corner

30, forming an annulus (doughnut shape) of conductive material which has been referred to as the corner fill 32 of the present invention. (emphasis added).

There is simply nothing in Roberts which teaches a device having both large and small-diameter holes, an essential limitation of the claims on appeal. The Examiner has agreed that this essential limitation is not shown by art of record. See, Paragraph 9 of the Official Action mailed May 25, 1999. Moreover, there is nothing in Roberts which even remotely suggest simultaneous partial filling of a large and complete filling of a small-diameter contact hole. In fact, Roberts teaches away from the claimed invention by teaching localized partial filling of a contact hole by sputtering material from a facet etch. Even if small-diameter holes were disclosed in Roberts, the sputtering of material into the large-diameter contact hole of Roberts belies the notion that there could be simultaneous complete filling of small-diameter holes.

Miller et al. fails to provide the missing teachings, either alone or in combination with Roberts. Miller et al ("Miller") teaches a structure, as shown in FIGS. 4-6 thereof, for protecting a barrier metal layer 2 within a contact opening 30 during formation of an aluminum interconnection layer 6 overlying a tungsten plugged connection structure. Col. 5, lines 23-24. The deposited tungsten plug 20 overlying the barrier metal layer 2 is etched back sufficiently to create a slight recess 31 at the opening. Col. 5, lines 57-59. A thin layer of tungsten 22 is then selectively deposited for filling the recess 31. Col. 6, lines 17-20. The layer 22 of tungsten acts as an etch stop during interconnection layer formation and protects the underlying barrier metal layer. Col. 6, lines 20-24.

4 The Examiner cites Miller as teaching the filling of a small-diameter contact hole with a metal plug. Independent claim 1, however, requires that the small-diameter contact hole "penetrate through an insulator film formed on a conductive portion to reach said conductive portion", and that the hole be "completely filled" with refractory material simultaneously with the partial filling of a large-diameter contact hole. It is abundantly clear that hole 30 in Miller et al is not "completely filled" by refractory material, as required by independent claim 1. Instead, as shown for example in the cover figure, a barrier metal layer 2 is formed in the contact hole to cover the sidewalls thereof and the exposed portion of the substrate 10. The plug 20 is then deposited over the barrier metal layer 2.

5 Moreover there is nothing in Miller et al which teaches or suggests a device having both small and large-diameter contact holes. There cannot, therefore, be any teaching or suggestion of a device wherein a large-diameter contact hole is partially filled and a small-diameter contact hole is simultaneously completely filled by a refractory material, as required by the claims on Appeal. Again, Miller does not even teach complete filling of a small-diameter hole by a refractory plug. Miller et al. is also completely devoid of any teaching or suggestion of a device wherein each large-diameter contact hole and each small-diameter contact hole has a "funnel shaped portion" on an "upper portion thereof", as required by be dependent claim 2, and claims 3-6 which depend therefrom.

Despite the significant differences between Roberts, Miller and the claimed invention, the Examiner argues that "since both large and small-diameter holes are

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shown in the prior art, it is obvious to combine the two techniques to provide contacting capability with the widest applicability." Paragraph 9 of the Official Action mailed May 25, 1999. There is, however, no combination of Roberts and Miller which one could make to achieve the claimed invention. Roberts teaches partial filling of a contact hole by sputtering during a facet etch, and Miller fails to teach or suggest even complete filling of a small-diameter contact hole. Combining these teachings simply would not result in a device wherein a large-diameter contact hole is partially filled and a small-diameter contact hole is simultaneously completely filled by a refractory material.

Even if the references could be combined or modified to achieve the claimed invention, there is no suggestion or motivation, either implicit or explicit, in the references which would have prompted one skilled in the art to combine the teachings. In fact, the Examiner has failed to identify any such suggestion or motivation. As the Board knows, the initial burden of establishing a *prima facie* case of obviousness rests upon the Examiner. See, e.g., MPEP 2143. Three criteria must be met to establish a *prima facie* case of obviousness:

- (1) there must be some suggestion or motivation in the references to combine the reference teachings;
- (2) there must be some expectation of success; and
- (3) the combined references must teach or suggest all of the claimed limitations.

Id.; In re Dow Chemical Co., 837 F.2d 469, 5 USPQ2d 1529 (Fed. Cir. 1988). In establishing a *prima facie* case of obviousness under 35 USC 103, it is incumbent upon the Examiner to provide a "clear and particular" showing of "actual evidence" of a

suggestion, teaching, or motivation to combine references. In re Dembiczak, 50 USPQ 2d, 1614, 1617 (Fed. Cir. 1999). "Broad conclusory statements regarding the teachings of multiple references, standing alone, are not evidence." Id., citing McElmury v. Arkansas Power and Light Co., 995 F.2d 1576, 1578, 27 USPQ2d. 1129, 1131 (Fed. Cir. 1993) (internal quotations omitted).

In fact, in In re Dembiczak the Court of Appeals for the Federal Circuit recognized that "rigorous application" of the requirement for a showing of a teaching or motivation to combine references is the "best defense against the subtle but powerful attraction" of improper hindsight-based obvious analysis. Id.; See also, Para-Ordnance Manufacturing, Inc. v. SGS Importers International, Inc., 73 F.3d 1085, 37 USPQ2d 1237 (Fed. Cir. 1995). ("obviousness may not be established using hindsight or in view of the teachings or suggestions of the inventor"). This is especially true in cases where the ease with which the invention may be understood "may prompt one to fall victim to the insidious effect of hindsight syndrome wherein that which only the inventor taught is used against its teacher." Id. citing W.L. Gore & Assoc., Inc. v. Garlock, Inc., 721 F.2d 1540, 1553, 220 USPQ 303, 313 (Fed. Cir. 1983).

In addition to failing to cite references which teach or suggest all of the claimed limitations, either alone or in combination, the Examiner has failed to meet the requirement of clearly and particularly identifying actual evidence of a suggestion, teaching, or motivation to combine references. Instead, the Examiner has merely provided "broad conclusory" statements, in a manner which has explicitly been rejected

by the Court of Appeal for the Federal Circuit. See, *Id.* In particular, the Examiner has broadened argued that:

1. "[i]t would have been obvious to include a technique for filling a high aspect ratio hole along with an approach to filling a low aspect ratio hole to provide a broader applicability to the electroding technique" (Paragraph 3 of the Official Action mailed May 25, 1999); and

2. "since both large and small-diameter holes are shown in the prior art, it is obvious to combine the two techniques to provide contacting capability with the widest applicability." (Paragraph 9 of the Official Action mailed May 25, 1999).

These statements simply do not provide a clear and particular showing of a suggestion or motivation to combine the references. The Examiner has, therefore, failed to establish a *prima facie* case of obviousness. In fact, considering that the references fail to teach or suggest essential limitations of the claims on Appeal, only with the benefit of hindsight and imagination would one consider combining the references to achieve the claimed invention. The Court of Appeals for the Federal Circuit has consistently rejected such an approach.

Thus, neither Roberts nor Miller, nor there combination, teaches or suggests a "device including both a large-diameter contact hole and a small-diameter contact hole" wherein a "refractory conductive material is simultaneously deposited in said small-diameter hole and said large-diameter hole" so that the small-diameter hole is "completely filled" with the refractory material and the large-diameter hole is partly filled with the refractory material "covering a sidewall surface to below the upper end

of said large-diameter contact hole by a predetermined distance", as required by independent claim 1, and, therefore, all of the claims on Appeal. Moreover, there is nothing in the combination of Roberts and Miller which teaches or suggest a device wherein each large-diameter contact hole and each small-diameter contact hole has a "funnel shaped portion" on an "upper portion thereof", as required by be dependent claim 2, and claims 3-6 which depend therefrom. For the foregoing reasons, therefore, Appellant respectfully submits that the Examiner's rejection of claims 1-4, 7 and 8 under 35 U.S.C. §103(a) as being upatentable over Roberts et al. in view of Miller et al, should be reversed by the Board. Reversal is, therefore, respectfully requested.

- (2). Rejection of claims 1-4, 7 and 8 under 35 U.S.C. §103(a) as being unpatentable over Roberts et al. in view of Miller et al.

The Examiner has combined the teachings of McDavid and Miller to reject claims 1-4, 7 and 8 under 35 U.S.C. §103(a). In making this rejection, the Examiner states:

With respect to claims 1-4, 7 and 8, McDavid shows (see cover Figure and column 2, line 19-line 61) a structure with a wide via (low aspect ratio) in an insulating layer 21 where a tapered refractory metal layer 13 is formed in the corners of the hole to improve step coverage of the metal film 10 and the upper end of the hole is funnel shaped. Miller et al. show (see cover Figure and column 5, line 22-column 6, line 30) the filling of a high aspect ratio hole (column 2, line 43) with a refractory metal plug. It would have been obvious to include a technique for filling a high aspect ratio hole with an approach to filing a low aspect ratio hole to provide a broader applicability of the electroding technique. Paragraph 5 of the Official Action mailed May 25, 1999.

The primary reference to McDavid teaches a metalization process wherein metal contacts and interconnections for integrated circuits are formed by a process of two metal depositions to increase step or sidewall coverage. Col. 2, lines 30-32. After a first layer of metal 23 is deposited, a preferential etch removes all of the metal except on the metal 13 on the vertical sides of steps or apertures 14. Col. 2, lines 32-40. A second layer of metal 10 is deposited over the remaining parts of the first layer 23, resulting in smoother transitions and greater thickness at the sidewalls of the apertures 14. Col. 2, lines 54-59.

Again, however, the Examiner acknowledges that McDavid fails to teach or suggest a device having both large-diameter and small-diameter holes. See Paragraph 9 of the Official Action mailed May 25, 1999. There is, therefore, nothing in McDavid which teaches or suggests, simultaneous partial filling of a large-diameter hole and complete filling of a small-diameter hole, as required by all of the claims on Appeal. Moreover, there is nothing McDavid which teaches or suggest a device wherein each large-diameter contact hole and each small-diameter contact hole has a "funnel shaped portion" on an "upper portion thereof", as required by be dependent claim 2, and claims 3-6 which depend therefrom. In fact, McDavid specifically states that "the sidewalls of the hole 14 are nearly vertical, or in some cases may be undercut. . ." (emphasis added).

The discussion of Miller et al. provided above is repeated and an incorporated herein by reference. Again, Miller fails to provide the missing teachings, and, contrary to the Examiner's assertions fails to teach or suggest a device wherein a contact hole is

"completely filled" by a refractory material, as required by independent claim 1.

Instead, Miller teaches a barrier layer formed on the surfaces of a contact hole with plug of material 20 disposed in the barrier layer. The material 20 does not completely fill a hole formed in a conductive portion "to reach said conductive portion."

Thus, there is no combination of McDavid and Miller which one could make to achieve the claimed invention. Even if such a combination did exist, there would have been no suggestion or motivation for one to combine the references at the time the invention was made. The Examiner has failed to clearly and particularly identify such a teaching or suggestion, and has, therefore, failed to establish a *prima facie* case of obviousness.

In particular, the Examiner has merely argued that "it would have been obvious to include a technique for filling a high aspect ratio hole along with an approach to filling a low aspect ratio hole to provide broader applicability to the electroding technique. Paragraph 5 of the Official Action mailed May 25, 1999. This is exactly the kind of broad and conclusory statement, supported by no clear and particular reasoning or actual evidence, which has been expressly rejected by the Court of Appeals for the Federal Circuit as a basis for an obviousness rejection. See, In re Dembiczak, supra. Only through hindsight in reading the Appellant's disclosure would one consider combining the references to achieve the claimed invention. It is well-established, however, that "obviousness may not be established using hindsight or in view of the teachings or suggestions of the inventor." Para-Ordnance Manufacturing, Inc. v. SGS Importers International, Inc., 73 F.3d 1085, 37 USPQ2d 1237 (Fed. Cir. 1995).

Thus, neither McDavid nor Miller, nor their combination, teaches or suggests a "device including both a large-diameter contact hole and a small-diameter contact hole" wherein a "refractory conductive material is simultaneously deposited in said small-diameter hole and said large-diameter hole" so that the small-diameter hole is "completely filled" with the refractory material and the large-diameter hole is partly filled with the refractory material "covering a sidewall surface to below the upper end of said large-diameter contact hole by a predetermined distance", as required by independent claim 1, and, therefore, all of the claims on Appeal. Moreover, there is nothing in McDavid or Miller, or their combination, which teaches or suggests a device wherein each large-diameter contact hole and each small-diameter contact hole has a "funnel shaped portion" on an "upper portion thereof", as required by dependent claim 2, and claims 3-6 which depend therefrom. For the foregoing reasons, therefore, Appellant respectfully submits that the Examiner's rejection of claims 1-4, 7 and 8 under 35 U.S.C. §103(a) as being unpatentable over McDavid in view of Miller et al., should be reversed by the Board. Reversal is, therefore, respectfully requested.

(3). Rejection of claims 5, 6, 9, and 10 under 35 U.S.C. §103(a) as being unpatentable over McDavid and Roberts et al. in view of Miller et al.

The Examiner has combined the teachings of Roberts, McDavid and Miller to reject claims 5, 6, 9, and 10 under 35 U.S.C. §103(a). In making this rejection, the Examiner states:

McDavid shows a refractory layer which is high in form and Roberts et al. show a refractory layer that is low in form. Since both show a useful structure it would have been obvious to use any form in-between the two. Paragraph 7 of the Official Action mailed May 25, 1999. (emphasis added).

The discussions of Roberts, McDavid and Miller et al. provided above are repeated and incorporated herein by reference. Again, none of these references, either alone or in combination, teaches or suggests, simultaneous partial filling of a large-diameter hole and complete filling of a small-diameter hole, as required by independent claim 1. Claims 5, 6, 9 and 10 all depend, either directly or ultimately, from claim 1. Reversal of the rejection is therefore respectfully requested based on the arguments set forth above with respect to Roberts, McDavid and Miller.

In addition, claims 5 and 6 depend from claim 2. There is nothing in the combination of Roberts, McDavid and Miller which teaches or suggests a device wherein each large-diameter contact hole and each small-diameter contact hole has a "funnel shaped portion" on an "upper portion thereof", as required by dependent claim 2. In fact, there is no combination of these references that one could make to achieve the invention of claim 2 and claims 5 and 6, which depend therefrom.

Moreover, the Examiner has not identified any teaching of these limitations in the references, and has not clearly and particularly shown any actual evidence of a suggestion or motivation to combine the references. The only statement made by the Examiner in this regard is: "Since both [Roberts and McDavid] show a useful structure it would have been obvious to use any form in-between the two." Paragraph 7 of the Official Action mailed May 25, 1999. This statement is broad, conclusory, and

unsupported by any clear and particular showing of any suggestion or motivation for combining the cited references. In fact, the Examiner fails to even address how Miller might be combined with Roberts and McDavid. Again, therefore, the Examiner has failed to establish a *prima facie* case of obviousness.

It is abundantly clear that neither Roberts nor McDavid nor Miller, nor there combination, teaches or suggests a "device including both a large-diameter contact hole and a small-diameter contact hole" wherein a "refractory conductive material is simultaneously deposited in said small-diameter hole and said large-diameter hole" so that the small-diameter hole is "completely filled" with the refractory material and the large-diameter hole is partly filled with the refractory material "covering a sidewall surface to below the upper end of said large-diameter contact hole by a predetermined distance", as required by independent claim 1, and, therefore, all of the claims on Appeal. Moreover, there is nothing the combination of these references which teaches or suggest a device wherein each large-diameter contact hole and each small-diameter contact hole has a "funnel shaped portion" on an "upper portion thereof", as required by be dependent claim 2, and claims 5 and 6, which depend therefrom. For the foregoing reasons, therefore, Appellant respectfully submits that the Examiner's rejection of claims 5, 6, 9 and 10 under 35 U.S.C. §103(a) as being upatentable over McDavid and Roberts in view of Miller et al., should be reversed by the Board. Reversal is, therefore, respectfully requested.

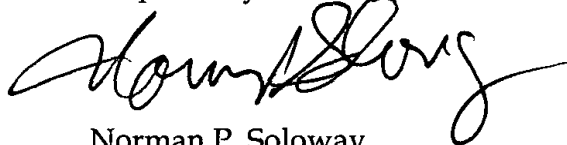
Summary

Appellant has previously in this brief responded to the various arguments raised by the Examiner in the Final Rejection. In the foregoing, Appellant has shown that the references cited by the Examiner fail to teach or suggest, either alone or in combination, all of the essential elements of the claimed invention. In addition, Appellant has shown that, even if the references could be combined in the cited manner, the Examiner has not provided a "clear and particular" showing of "actual evidence" of a suggestion, teaching, or motivation to combine references. See, In re Dembiczak, 50 USPQ 2d 1614 (Fed. Cir. 1999). The broad, conclusory statements relied upon the Examiner fail to establish a *prima facie* case of obviousness, and can only be derived from an improper hindsight-based analysis.

Reversal of the Final Rejection of the claims on Appeal is respectfully requested.

In the event there are any fee deficiencies or additional fees are payable, please charge them (or credit any overpayment) to our Deposit Account No. 08-1391.

Respectfully submitted,



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CERTIFICATE OF MAILING

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By Kristine Stewer

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